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# Health Problems Presented to Family Practices in The Netherlands 1 Year Before and 1 Year After a Disaster

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**Background:** Disasters often have negative health consequences. Studies of health problems presented in family practice before and after a disaster are rare. The present study analyzed health problems before and after a disaster and predictors of increased morbidity after the disaster as presented in family practice.

**Methods:** A matched cohort study design with measurements 1 year before the disaster and 1 year after the disaster. Victims (N = 9183) and matched controls (N = 7066) were surveyed in the electronic medical records of 30 family practices after the explosions of a fireworks depot in The Netherlands. All health problems were registered using the International Classification of Primary Care.

**Results:** Victims showed significantly higher prevalence rates for psychological problems after the disaster than before the disaster (422 vs 133 per 1000 person-years;  $P < .001$ ) and for problems of the musculoskeletal system (450 vs 401 per 1000 person-years;  $P < .05$ ).

Relocation because of the disaster (odds ratio, 10.65; 95% confidence interval, 8.15–13.94) and, to a lesser degree, psychological morbidity before the disaster (odds ratio, 2.31; 95% confidence interval, 1.42–3.76) were the strongest predictors of psychological problems after the disaster.

**Conclusion:** The results suggested that forced relocation and a history of psychological problems were risk factors to post-disaster psychological problems of victims presenting to a family practice. (J Am Board Fam Med 2007;20:548–556.)

Experiencing a disaster is an emotionally charged event. The terror, the fear, and the inability to cope may lead to serious health consequences for the victims in the short term as well as the long term. Victims present health problems, both psychological and physical, in the aftermath of any natural or man-made disaster.<sup>1–6</sup> In her review, Norris<sup>7</sup> concluded that people who experienced man-made or

technological disasters were not significantly more distressed, on average, than people who experienced natural disasters. The problem with research about health problems after disasters is that every disaster is unique and occurs in specific communities in a specific period. However, one of the generic aspects is that disasters tend to occur especially in deprived areas where people live below sea level, on the slopes of volcanoes, or near chemical plants.

One of the theoretical frameworks for health consequences of disasters is the Conservation of Resources stress theory.<sup>8–10</sup> This theory proposes that people often possess a number of resources that are used to cope with their life circumstances and that loss results in increased physical and psychological distress and further diminished coping capacities. In the event of a disaster, often in deprived areas, it is an important principle that “resource loss is disproportionately more salient than

This article was externally peer reviewed.

Submitted 1 May 2006; revised 30 January 2007; accepted 5 February 2007.

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**Funding:** This study was funded by a grant obtained from the Ministry of Public Health, Welfare, and Sports in The Netherlands.

**Conflict of interest:** none declared.

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resource gain” and that “those who lack resources are not only more vulnerable to resource loss but that initial loss begets future loss.”<sup>10</sup> The degree of exposure to a disaster,<sup>11,12</sup> relocation<sup>13,14</sup> and psychological problems before a disaster<sup>15–17</sup> are all considered important risk factors for problems after a disaster. Therefore, for people with few resources before a disaster, it is nearly impossible to gain new resources thereafter.

On 13 May 2000, a firework depot exploded in the city of Enschede (125,000 inhabitants) in the eastern part of The Netherlands. The explosions totally destroyed a neighborhood in only a few hours. Approximately 1200 people lost their homes and had to be relocated for a long period of time. Moreover, 18 residents and 4 firefighters were killed and approximately 1000 people were wounded.

The Dutch government offered support to the local authorities and health care workers. A municipal Information and Advice Center (IAC) was implemented where all victims could be registered and an integrated post-disaster health care facility was set up, in which all disciplines of psychosocial and physical health care were represented, including family practice. In the present study, the health problems of residents and passers-by living in town are presented using the electronic medical records (EMRs) of family physicians (FPs).

The objective of the study is 2-fold: (1) to analyze health problems of patients, whether affected by the disaster or not, as presented in family practice 1 year before and 1 year after the disaster; and (2) to explore the risk factors that may contribute to an increase of the presentation of health problems in the first year after the disaster.

## Methods

### Setting

In the Dutch health care system, every citizen is registered with one FP who acts as a gatekeeper to secondary care. As a result, victims of the disaster were known to their FP before the disaster. A patient enlists in the practice of his choice, which is often located in the neighborhood of their home.

We asked all 60 FPs in the town to participate in this study and 44 of them did so (30 practices; 73%). Sixteen did not participate for 3 different reasons: 6 expected an increase in workload, 9 had no victims among their patients, and 1 did not use an electronic registration system.

Patients were informed about the participation of their FP in this study through leaflets in their doctor's waiting room and the local newspapers, and they could object to the use of their data (no one did so). The data remained anonymous. Data collection was performed in accordance with the privacy protection procedures of the Dutch Data Protection Authority, and no explicit ethical approval or informed consent was needed.<sup>18</sup>

### Victims

In total, approximately 12,000 people were registered as a victim either by their FP or by the authorities in the database of the IAC. Of these 12,000 victims, approximately 1,600 people (passers-by and rescue workers) could not be included in the study because they were not residents.

The remaining 10,398 patients were all listed in family practices. Patients were marked as a victim in the FP's EMRs when they were resident of the destroyed or the surrounding areas (postal code). At the IAC, people were registered as a victim based on the municipal identity register and by self-adherence when they considered themselves as a victim. They all received a research number that allowed them to be followed anonymously in both databases.

Of the remaining group, 11% could not be included because they were enlisted in nonparticipating practices. Of the victim group ( $N = 9254$ ), 9183 patients were still registered in the EMRs of their FP after 1 year. This group was included as victims in our cohort.

If FPs' patients were neither marked by the FP or the municipal IAC and were not a resident of the destroyed area, they were included as a control. They were on the lists of the same study practices. We randomly selected as many controls as victims and stratified for sex and age.

### Key Variables

The independent variables of relocation and non-relocation were taken from the IAC database. A victim was distinguished as relocated when his or her ZIP code in the affected area changed after the disaster took place. Relocation was inevitable because of the destruction of their homes by shock waves and fire. If not, they were nonrelocated victims.

The other independent variables, which included psychological problems presenting before

**Table 1. Characteristics of Victims and Controls Registered on Their Family Practitioner's List Between May 1999 and May 2001**

Victim Groups	Victims (n = 9183)	Controls (n = 7066)
Mean age (years)	38.5	37.9
Men	52.8	52.0
Children <15 years of age	13.7	14.4
Low/medium SES*	70.4	67.1
Psychological problems before disaster	9.5	9.2
Relocated	8.8	—
No contact with family practitioner	5.8	6.4

All data presented as percentage, except mean age. SES, socioeconomic status.

\* $P < .001$  (between victims and controls).

the disaster, sex, age, and socioeconomic status (SES) were extracted from the EMRs. The variable of psychological problems before the disaster was applied to victims and controls who had visited their FP at least once in the year before the disaster for a problem classified in this group. Health insurance was used as a proxy for SES because it is directly related to income in The Netherlands. If a person receives public health insurance, a lower or medium SES is assumed, whereas private health insurance indicates a higher SES.

The dependent variables were collected in the EMRs. These included all morbidity and psychological problems as presented by the patient to the FP (whether they were a victim or not). The outcome variable was whether or not a patient contacted the FP at least once in the year either before or after the disaster. All presented symptoms and diagnoses registered during consultations, visits, or telephone contacts were extracted and were classified in International Classification of Primary Care (ICPC), which is compatible with the International Classification of Diseases<sup>19</sup> and with the Diagnostic and Statistical Manual of Mental Disorders.<sup>20</sup> They were analyzed separately and were grouped together in the organ-based clusters of the ICPC classification, such as the digestive or musculoskeletal cluster. Moreover, in accordance with the ICPC, one cluster with social problems (eg, housing problems, loss of spouse) and another cluster with psychological problems (eg, anxiety, sleeping problems, major depression) were used.

In our study, data on all problems were extracted anonymously from the EMR of all patients (victims and controls) every 3 months. Data from 1 year before the disaster were extracted retrospectively.

### **Statistical Analysis**

Demographic data about the patients in both the victim and control groups were compared using  $\chi^2$  tests. Prevalence rates per 1000 people in the year before the disaster and the year after the disaster were calculated as the number of victims or controls presenting problems divided by the numbers of victims or controls. The number of person-years during which problems were counted was taken into account, as was the time that elapsed before problems were presented (as recommended by Rothman and Greenland<sup>21</sup>).

Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for the ICPC-coded symptoms and diagnoses to test differences before and after the disaster between victims and controls. Table 3 presents those symptoms and diagnoses that are most sensitive to a change in OR with 95% CI because of the disaster.

A logistic regression model was tested to compare the increase in clusters of health problems after the disaster in victims and controls. This amounted to the formal test that the ORs for victims before and after the disaster were statistically significantly higher than the corresponding ORs for controls with regard to the various health problems ( $\alpha$  set at 5%). ORs were calculated with 95% CIs. The selection criterion was a high prevalence rate after the disaster within the ICPC clusters. Moreover, differences between victims and controls in the same health clusters before the disaster were tested.

Six predictor variables were included in a multilevel (MIWin) model. Two dummy variables were used for the coding of group membership: relocated victims [yes = 1, no = 0] and nonre-

**Table 2. Health Problems of Victims and Controls 1 Year Before and 1 Year After the Disaster\* in International Classification of Primary Care Clusters**

ICPC Cluster†	Victims		Controls	
	Before Disaster	After Disaster	Before Disaster	After Disaster
Musculoskeletal	418	450‡	404	401
Psychological	131	422§	129	133
Respiratory	399	388	363	348
Others¶	359**	358	335	335
Skin	303††	321	321	314
Digestive	180	198	170	177
General	167	197	143	154
Circulatory	151	158	150	154
Neurological	112**	116	94	89
Ear	106	113	104	102
Social	50**	106§	41	47
Endocrine	81	85	77	81
Urinary	67	74	60	67

ICPC, International Classification of Primary Care.

\*13 May 1999 through 12 May 2001.

†Data provided as prevalence rates per 1000 person-years.

¶"Others" includes "blood, blood forming," "eye," "pregnancy, childbearing, family planning," "female genital," and "male genital."

Differences between victims and controls with regard to rates before the disaster: †† $P < .05$ ; \*\* $P < .01$ ; || $P < .001$ .

Differences between victims and controls with regard to changes between rates before the disaster and rates after the disaster: ‡ $P < .05$ , § $P < .001$ .

located victims (yes = 1, no = 0); reference category is controls]. Another dummy variable indicated whether a patient presented with psychological problems before the disaster (yes = 1, reference category of no psychological problems before the disaster = 0). The 3 other variables in the equation were sex (female = 1, male = 0); socioeconomic status (low/medium SES = 1, high SES = 0); and age (divided by 10 years). Age was converted into periods of 10 years because its original scale in years (range, 0 to 100) made comparisons difficult with other predictors (with values 0 and 1).

Two different multilevel logistic regression models were used to analyze the association between predictor variables and 2 significantly increased after-disaster clusters of problems (see Table 4). The cluster of social problems was not included in the multilevel model being indissolubly related to the disaster. All interactions between the 2 types of victim groups, relocated or not, were included in the models to analyze whether the relation between the predictor variables and the outcome variables were different for the 2 victim groups compared with the controls.

## Results

More than half of the population was male; mean age was approximately 38 years. Victims and controls did not differ with respect to sex and age. Moreover, the percentages within the groups of victims and controls presenting with psychological problems before the disaster and those who did or did not contact their FP during the entire study period did not differ (Table 1). The victims more often had a lower/medium SES ( $P < .001$ ) compared with controls.

### Physical and Psychological Health Problems

In the period before the disaster, victims had significantly higher prevalence rates than the controls for respiratory (399 vs 363 per 1000 person-years;  $P < .001$ ); "general" (eg, fatigue; 167 vs 143 per 1000 person-years;  $P < .001$ ); neurological (112 vs 94 per 1000 person-years;  $P < .01$ ); social (50 vs 41 per 1000 person-years;  $P < .01$ ); and "other" (359 vs 335 per 1000 person-years;  $P < .01$ ) clusters. Only the prevalence rates of the skin problems before the disaster (303 vs 321 per 1000 person-years;  $P < .05$ ) were significantly lower in victims than in controls (Table 2).

**Table 3. Prevalence Rates and Odds Ratios Ranked in Order of Specific Health Problems 1 Year Before and 1 Year After the Disaster in Victims and Controls 1 Year After the Disaster\***

Health Problem	Victims (n)		Controls (n)		Odds Ratio†	95% Confidence Interval
	Before Disaster	After Disaster	Before Disaster	After Disaster		
Acute stress	9	273	11	19	15.96	10.95–23.27
Problems with housing/ neighborhood	2	26	1	1	13.16	4.23–40.96
Loss/death of parent/family	4	12	4	3	4.26	2.04–8.93
Herpes zoster	4	6	5	3	2.65	1.31–5.36
Abrasion/scratch/ blister	5	7	5	4	2.36	1.21–4.63
Hyperventilation	7	13	8	7	2.26	1.35–3.76
Disturbance of sleep/insomnia	28	55	33	30	2.21	1.72–2.84
Feeling anxious/nervous/tense	23	43	24	20	2.20	1.64–2.95
Palpitations	9	12	9	5	2.20	1.32–3.69
Anxiety disorder	9	16	7	6	2.19	1.31–3.67
Other infection of the eye/uveitis	5	8	4	3	2.10	1.02–4.34
Depressive disorder	21	28	19	18	1.44	1.05–1.99
Laceration/cut	18	23	18	17	1.43	1.02–2.01
Neck symptoms	34	45	33	35	1.29	1.01–1.65

\*13 May 2000 through 12 May 2001.

†Odds ratio shows the risk of victims' health problems after the disaster as related to the controls and risk before the disaster.

Comparing the periods before and after the disaster, victims showed higher prevalence rates for almost all organ systems, indicating increased illness diversity. Compared with controls, victims had higher prevalence rates after the disaster for 3 clusters: psychological problems (422 vs.133 per 1000 person-years;  $P < .001$ ); social problems (106 vs 47 per 1000 person-years;  $P < .001$ ); and musculoskeletal problems (450 vs 401 per 1000 person-years;  $P < .05$ ).

The individual problems of victims compared with controls were analyzed using ORs. Acute stress problems (OR, 15.96; 95% CI, 10.95–23.27) and problems with housing (OR, 13.16; 95% CI, 4.23–40.96) showed the strongest relation to the disaster (Table 3). Another problem was loss of parent/family (OR, 4.26; 95% CI, 2.04–8.93). Other health problems with a statistically significant relation to the disaster but a lower OR were, Herpes zoster, wounds, hyperventilation, sleeplessness, feeling anxious and anxiety disorders, uveitis, etc.

#### ***Predictors of Disaster-Related Clusters of Health Problems***

Victims who had to relocate because of the disaster had the highest probability (OR, 10.65; 95% CI, 8.15–13.94) of presenting to their FP with psycho-

logical problems in the period after the disaster (Table 4). Nonrelocated victims also had an increased probability (OR, 4.24; 95% CI, 3.58–5.03) of presenting with these kind of problems.

Women had a higher probability of presenting psychological problems after the disaster than did men, but this applied to victims and controls alike. The ORs (controls, OR 1.26; relocated victims, OR 1.56, and nonrelocated victims, OR 1.53) did not differ in statistical significance, indicating that women in general present to their FP with more psychological problems than do men, irrespective of the disaster.

People of low/medium SES also had a higher probability of presenting with psychological problems after the disaster than did people with a high SES but, again, this applied to both victims and controls. The ORs (controls, OR 1.48; relocated victims, OR 1.04; nonrelocated victims, OR 1.43) did not differ in statistical significance, indicating that people with a low/medium SES did not present more psychological problems to their FP than did people with a high SES.

Older people had a higher probability of presenting psychological problems after the disaster compared with younger people. However, the relation between age and presentation of psychological problems differed statistically significantly be-



**Table 4. Odds Ratios and 95% Confidence Intervals Calculated from Multilevel Logistic Regression Models Analyzing the Probability of Visiting the Family Practitioner for Psychological and Musculoskeletal Problems in the Year After the Disaster**

	Psychological		Musculoskeletal	
	OR	95% CI	OR	95% CI
Constant	0.08		0.50	
Relocated victims (ref controls)	10.65	8.15–13.94	0.98	0.76–1.26
Nonrelocated victims (ref controls)	4.24	3.58–5.03	1.20	1.06–1.35
Women in interaction with:				
Controls	1.26	1.07–1.49	1.15	1.03–1.28
Relocated victims	1.56	1.17–2.08	1.05	0.78–1.42
Nonrelocated victims	1.53	1.37–1.69	1.15	1.04–1.26
Low/medium SES in interaction with:				
Controls	1.48	1.22–1.80	1.54	1.36–1.74
Relocated victims	1.04	0.70–1.80	1.06	0.70–1.60
Nonrelocated victims	1.43	1.27–1.61	1.36	1.22–1.51
Age in interaction with:				
Controls	1.14	1.09–1.18	1.15	1.12–1.18
Relocated victims	1.17	1.08–1.25	1.17	1.08–1.26
Nonrelocated victims	1.08*	1.05–1.10	1.15	1.12–1.18
Psychological problems before the disaster in interaction with:				
Controls	8.11	6.80–9.67	1.27	1.09–1.49
Relocated victims	2.31*	1.42–3.76	1.91	1.23–2.97
Nonrelocated victims	3.59*	3.10–4.15	1.44	1.25–1.65

OR, odds ratio; CI, confidence interval.

\*Odd ratios of victims and controls that differ statistically significantly.

tween the groups. The nonrelocated victims had a lower OR (OR, 1.08; 95% CI, 1.05–1.10) than the controls and the relocated victims, pointing to the fact that age in the group of nonrelocated victims had a smaller effect on the presentation of psychological problems after the disaster than in the other groups.

The last predictor was whether someone presented psychological problems or not in the year before the disaster. The ORs differed statistically significantly between victims and controls. Controls who presented psychological problems before the disaster had a higher probability of presenting psychological problems after the disaster compared with controls who did not present psychological problems before the disaster (OR, 8.11; 95% CI, 6.80–9.67). This is, of course, not related to the disaster but merely because, in normal circumstances, someone who presents psychological problems in 1 year has an increased probability of presenting psychological problems in the following year. Relocated victims who presented psychological problems before the disaster had an increased

probability of presenting psychological problems after the disaster (OR, 2.31; 95% CI, 1.42–3.76) compared with relocated victims without psychological problems before the disaster. This is also the case for nonrelocated victims (OR, 3.59; 95% CI, 3.10–4.15). Being a nonrelocated victim reduced the effect of the predictor of presenting psychological problems before the disaster considerably (compare OR of 8.11 with OR of 3.59); being a relocated victim further reduced that effect (compare OR of 8.11 with OR of 2.31). Still, relocated victims with psychological problems before the disaster showed a higher OR ( $2.31 \times 10.65 = 24.60$ ) than did nonrelocated victims with the same problems ( $3.59 \times 4.24 = 17.98$ ).

With regards to musculoskeletal problems, only nonrelocated victims showed an increase (OR, 1.20; 95% CI, 1.06–1.35). Female sex, low/medium SES, age, and having psychological problems before the disaster also had an effect on the presentation of musculoskeletal problems, but the differences between the ORs of victims and controls were not statistically significant, indicating that the

disaster had no differential effect on any of these outcome variables.

## Discussion

In this study, we found an increase in psychological and musculoskeletal morbidity presented to the FP when comparing patients directly affected by a fire-works depot explosion to other patients in the same city who were not directly affected. The strongest predictors of morbidity were forced relocation because of destruction of dwellings, the presentation of psychological problems before the disaster occurred and, to a lesser degree, being a victim without forced relocation. Relocation because of the disaster and the loss of all personal belongings may be considered a traumatic experience: the victim has to leave his or her dwelling because of collapse or a risk of collapse caused by the enormous air pressure or by the extended fires throughout the area.

If victims, whether relocated or not, had a history of presenting psychological problems before the disaster, they had an even higher risk of presenting psychological problems after the disaster than did victims without such a history, with the risk in relocated victims being the highest.

Another remarkable finding among the predictors is that female sex, age, and SES seemed to have a contribution to psychological problems after the disaster, however irrespective of the disaster. The contribution of sex, age, and SES was not higher for victims than for controls. In our opinion, this important finding is a result of our design, containing baseline data from before the disaster. This result is in contrast to the findings of other studies (without data from before the disaster), as summarized in Norris<sup>7</sup> review.

The overrepresentation in the period before the disaster of 6 clusters of health problems among victims compared with controls is a remarkable finding. The significant difference between victims and the controls in SES may play a role in this higher number of social problems.<sup>22,23</sup> Moreover, victims who live in socially deprived areas are known to present a higher morbidity.<sup>1,24</sup>

Fourteen significantly increased, separate problems were found in the period after the disaster. Most of them could be related to the disaster. For the 2 social problems, the relationship is not surprising. For psychological problems such as acute

stress symptoms and anxiety disorder, this is rather obvious. Hyperventilation is related to fear and thus, a disaster-related connection can be supposed. Palpitations and neck symptoms (e.g. neck pain, no diagnosis like spondylosis) may be considered to be medically unexplained physical symptoms, as has been described after many disasters<sup>25</sup> and in family practice.<sup>26</sup>

The codes of uveitis and Herpes zoster are both related to immunologic factors.<sup>27-29</sup> In one study, performed after the Kobe earthquake, a increase in uveitis after the disaster was seen that was administered to psychological stress due to the disaster.<sup>30</sup> However, we have no explanation for this finding even though immunologic changes after disasters were described.<sup>31-33</sup> Moreover, the ORs of these 2 issues are based on low prevalence rates.

Some of our results can be viewed in the light of the Conservation of Resources stress theory,<sup>9,10</sup> which defines resources broadly to include objects (housing), conditions, and personal characteristics (psychological problems before a disaster). Resource loss is highly correlated with symptom severity in several disaster studies.<sup>34,35</sup>

## Limitations and Strengths

The present study has some important strengths. The study design is robust: comparisons with data from before the disaster and a control group were both possible, a design that is rather unique in the literature. Moreover, the majority of all of the victims (89%) were monitored, which makes it likely that the results of this study can be generalized to all victims of the disaster in Enschede. Finally, the problem of recall bias was avoided by using FPs' EMRs instead of self-reported questionnaires.

Some issues need to be considered. The type of health insurance represents a limited indication of SES because patients in The Netherlands with public health insurance (over 60% of the Dutch population) have a low or middle income. Low income as a separate characteristic could not be distinguished. Low income as a measure of low SES probably plays a more prominent role than we were able to show.

A substantial number of the relocated victims (approximately 400) moved outside of town or went to nonparticipating family practices in Enschede. Thus, we have no information about the characteristics or morbidity of these people. On the other hand, the most probable reason for relocation out-



side of town seems to be the lack of substituting dwellings in the town itself. Therefore, we have no reason to think that this group differed in exposure compared with the relocated group in our study.

In this study a risk of overrepresentation could have happened if the FP acted as the only source of victim identification. However, a victim claiming financial compensation at the municipal IAC could be marked by self-identification too. Self-identification of these victims (possibly less affected by this disaster) may have caused an underestimation of health effects. On the other hand, a victim may attribute his or her problems to the disaster: they may think that a symptom developed after the disaster, when in reality the FP found the symptom in the patients' history before the disaster.<sup>1</sup> Thus, the symptom is not related to the disaster. In this respect, we believe that an FP's evaluation of a patient's problems are more reliable than are self-reported symptoms. In addition, the use of EMRs has some advantages. Recall bias can be avoided and baseline data from before the disaster can be included. Moreover, the FPs were properly trained in the ICPC classification system and they received feedback on the quality of their registrations every 3 months.

### **Implications**

The present study shows that exposure to a man-made disaster not only resulted in increased psychological problems, but also in increased physical problems. The results emphasize the importance of supplying after-disaster interventions for stress reactions and anxiety problems, as well as for physical symptoms such as musculoskeletal symptoms. The results also suggest that victims who had to relocate because of the disaster and who had psychological problems before the disaster are most vulnerable to having psychological problems after the disaster.

The finding that relocated victims with psychological problems before the disaster had the highest risk for (psychological) health problems after the disaster is explained by their original small pool of resources, which was further depleted by the disaster. The role of the FP is to monitor the need for resource management to reduce negative health outcomes. In this respect, the electronic medical record can be used to identify victims with psychological problems during the year before the disaster and by instantly tracing relocated victims who had a change in postal code after the disaster.

The present study shows that family practice is a valuable source for collecting data about health problems before and after a disaster. The FP can play a role in the identification of high-risk victims and facilitate close monitoring after a disaster.

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We gratefully thank the participating family physicians for registering all contacts in times of pressure.

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